



THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of : **Confirmation No. 3927**
Ryoichi SHINJO et al. : Atty Docket No. 2001-0882A
Serial No. 09/885,102 : Group Art Unit 1711
Filed June 21, 2001 : Examiner Thao T. Tran
OZONE GENERATOR :

PATENT OFFICE FEE TRANSMITTAL FORM

Commissioner for Patents
P.O. Box 1450
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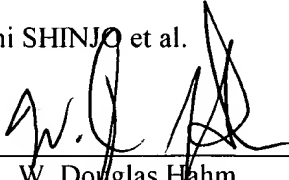
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Respectfully submitted,

Ryoichi SHINJO et al.

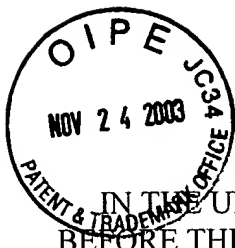
By


W. Douglas Hahm
Registration No. 44,142
Attorney for Applicants

WDH/gtg
WENDEROTH, LIND & PONACK, L.L.P.
2033 K St., N.W., Suite 800
Washington, D.C. 20006-1021
Telephone (202) 721-8200
November 24, 2003

[Check No. 5886]

2001_0882A



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

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APPELLANTS' BRIEF UNDER 37 CFR 1.192

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

The following is the Appellant's Brief, submitted in triplicate and in accordance with the provisions of 37 CFR 1.192.

1. REAL PARTY IN INTEREST.

The real party in interest is Ebara Corporation of Tokyo, Japan, the assignee of the present invention.

2. RELATED APPEALS AND INTERFERENCES.

There are no known related appeals or interferences.

3. STATUS OF CLAIMS.

Original claims 1- 12 were cancelled, and were replaced by claims 13-23. In the Final Office Action of April 23, 2003, the Examiner rejected claims 13, 14, and 16-22 in view of the prior art, but indicated that claims 15 and 23 contain allowable subject matter. Thus, the final rejections of claims 13, 14, and 16-22 are now being appealed. A complete copy of the claims on appeal is provided in the attached Appendix I.

4. STATUS OF AMENDMENTS.

There have been no amendments filed subsequent to the final rejections in this application.

5. SUMMARY OF THE INVENTION.

The present invention is directed to an improved ozone generator, and to an improved electric discharge cell of an ozone generator, for generating ozone to be used in processes such as water sterilization, oxidation bleaching, or semiconductor manufacturing. Although the need for ozone in these types of processes has rapidly increased in recent years, conventional ozone generators are generally inefficient, and the concentration of ozone produced by the conventional ozone generators is too low to meet the demand. As a result, the ability to use ozone in any of the processes discussed above is negatively impacted (see paragraph 9 on page 3 of the substitute specification).

In order to highlight the structural differences between the present invention and the prior art, a brief description of conventional ozone generators will first be provided with reference to Figures 11 and 12 of the present application. Figure 11 is a cross-sectional view of a portion of a conventional ozone generation apparatus, including a high-voltage electrode 13 and an earth electrode 14. As explained in paragraph 4 spanning pages 1 and 2 of the substitute specification, the gas flow passage of the conventional ozone generator shown in Figure 11 is arranged so that the material gas flows in a direction *parallel* to the grooves 16. In other words, the inlet port and the outlet port for the material gas are located such that the material gas will flow in a direction that is perpendicular to the surface of the paper on which Figure 11 is printed. During operation, and particularly during low-flow operation, the material gas flowing in a direction parallel to the grooves

16 will tend to collect in the area "Q" illustrated in Figure 12, rather than in the desirable area "P," where a high density of discharge is developed so as to easily generate a gas containing a high concentration of ozone. Thus, it is difficult to obtain a high concentration of ozone in the conventional ozone generators, particularly during low flow conditions (see paragraph 6 on page 2 of the substitute specification).

In view of the above problems, the inventors have determined that an ozone generator must be designed so that the material gas is *forced* to flow over the ridge portions (indicated by reference number 12 of Figure 12) of the high voltage electrode, where a high density of discharge is achieved. One arrangement of the present invention that achieves this result is illustrated in Figure 5 and described in paragraph 66 on page 13 of the substitute specification (and this embodiment corresponds to the embodiment of the invention recited in independent claim 13). In particular, a pair of electrodes, including a low-voltage electrode 22 and a high-voltage electrode 42 are spaced apart in an opposing relationship. At least one of the electrodes (low-voltage electrode 22) has a plurality of parallel grooves 23 formed on a surface thereof facing the gas flow space 24. Electrically conductive members 21, 49 connect the electrodes to a power source 17 so as to apply a voltage between the electrodes and thereby generate an electric discharge between the electrodes. A dielectric 43 is arranged between the electrodes. A gas flow passage 24 includes an inlet port (the opening between the electrodes located at the right side of Figure 5) for supplying a material gas G into the gas flow space, and includes an outlet port (the opening between the electrodes located at the left side of Figure 5) for discharging the material gas G from the gas flow space. As clearly illustrated in Figure 5, the gas flow passage 24 is arranged so that the material gas G flows through the gas flow space in a direction transverse (as indicated by the arrow) to a longitudinal direction of the parallel grooves. Due to the arrangement of the gas flow passage and the fact that the grooves are parallel, the material gas G is forced to flow over the ridge portions of the grooves 23, where a high density of discharge will be located during operation. Consequently, the concentration of ozone generated is greatly improved.

It is to be understood that the present invention is designed based on the well-known principle that fluids (and, specifically, gases) always flow from an area of high pressure (such as an

inlet port) to an area of low pressure (such as an outlet port). The present inventors determined that by applying this principle to conventional ozone generators and changing the *structural arrangement* of the gas flow passage including the inlet port and the outlet port, the material gas can be forced to flow over the ridges of the grooves so as to improve the generation of ozone.

An alternate embodiment of the present invention (as recited in independent claim 19) is illustrated in Figures 1 and 2, and described on pages 10 and 11 of the substitute specification. In particular, a pair of electrodes (low-voltage electrode 22 and high-voltage electrode 42) are spaced apart in an opposing relationship so as to form a gas flow space therebetween. One of the electrodes (the low-voltage electrode 22) has a plurality of concentric circular grooves 23 formed on a disc-shaped surface facing the gas flow space, and the other electrode has a flat dielectric plate 43 arranged on and covering a disc-shaped surface facing the gas flow space. Electrically conductive members are provided for connecting the electrodes to a power source (see paragraph 58 on page 10 of the substitute specification). A gas flow passage 24, 25, 26, 27, 28 includes an inlet port 25 for supplying a material gas into the gas flow space, and includes an outlet port 27, 28 for discharging the material gas from the gas flow space. The gas flow passage is arranged so that the material gas flows through the gas flow space in a radial direction transverse to the concentric circular grooves.

In an attempt to aid in the understanding of the flow of the material gas through the electric discharge cell of the second embodiment shown in Figures 1 and 2, a marked-up copy of Figures 1 and 2 has been prepared and submitted herewith as Appendix II. Although Figure 2 indicates that the gas enters the ozone generator electric discharge cell 100 through the inlet port 25 (located at the left-hand side of Figures 1 and 2), it is also possible for the flow of the material gas to be reversed so that the gas enters the electric discharge cell through guide passage 28. Consequently, in the attached marked-up Figures 1 and 2, the gas can enter the electric discharge cell at either location "B" or location "A," and the flow path is indicated by lines with arrows pointing in both directions. Regardless of the flow direction, it is clear from these drawings that, due to the location of the inlet port and the outlet port, the material gas *must flow* in a radial direction transverse to the concentric circular grooves formed on the surface of the low-voltage electrode 22. In other words, if the material gas enters through inlet passage 25, it must then flow from annular passage 26 (see Figure

2 of the application) toward central space 27 in a radial direction transverse to the concentric circular grooves as illustrated in the marked-up Figures. The material gas then flows from the central space 27 through the outlet passage 28 to be discharged. Alternatively, the material gas can enter the electric discharge cell through the guide passage 28 communicating with the central space 27. The material gas then *must flow* in a radial direction transverse to the concentric circular grooves from the central space 27 to the annular space 26 through space 24, and is then discharged through the outlet passage 25. Due to the arrangement of the gas flow passage and the fact that the grooves are concentric, the material gas G is forced to flow over the ridges of the concentric grooves 23 where a high density of discharge is located. Consequently, ozone generation is greatly improved.

6. ISSUES.

A first issue is whether claims 13 and 14 are anticipated under 35 USC 102(b) by Shinjo et. al., U.S. Patent No. 5,538,695 (“the Shinjo reference”).

A second issue is whether claims 13, 14, and 18 are anticipated under 35 USC 102(b) by Kamiya et. al., U.S. Patent No. 5,549,874 (“the Kamiya reference”).

A third issue is whether claim 13 is anticipated under 35 USC 102(b) by Duarte, U.S. Patent No. 5,554,344 (“the Duarte reference”).

A fourth issue is whether claims 13 and 14 are anticipated under 35 USC 102(b) by Japanese Document No. JP-2540627 (“the JP ‘627 reference”).

A fifth issue is whether claims 17, 19, and 21 are obvious under 35 USC 103 in view of the teachings of the Shinjo reference.

A sixth issue is whether claims 17 and 19-21 are obvious under 35 USC 103 in view of the teachings of the Kamiya reference.

A seventh issue is whether claims 16 and 22 are obvious under 35 USC 103 in view of the teachings of the Shinjo reference and the JP '627 reference, and further in view of Ishioka et. al., U.S. Patent No. 6,027,700, ("the Ishioka reference").

The above issues are more specifically directed to the following question: Is the functional language recited in the rejected claims to describe the arrangement of the gas flow passage with respect to the parallel or concentric grooves sufficient to distinguish the claimed invention from the applied prior art?

7. GROUPING OF CLAIMS.

Claims 13 and 19 do not stand or fall together.

Claims 14 and 16-18 stand or fall with claim 13.

Claims 20-22 stand or fall with claim 19.

8. ARGUMENT.

Claims 13, 14, and 16-18 are Patentable Over the Applied Prior Art.

Independent claim 13, and claims 14-18 that depend from claim 13, are directed to an ozone generator as described above. In particular, the ozone generator comprises a pair of electrodes spaced apart in an opposing relationship, and at least one of the electrodes has a plurality of parallel grooves formed on a surface thereof facing the gas flow space. A gas flow passage includes an inlet port for supplying a material gas into the gas flow space, and includes an outlet port for discharging material gas from the gas flow space, and the gas flow passage is arranged so that the material gas flows through the gas flow space in a direction transverse to a longitudinal direction of the parallel grooves.

In the final Office Action of April 23, 2003, the Examiner responded to the Applicant's arguments that the prior art references do not teach ozone generators with a gas flow passage

arranged as recited in independent claim 13. Specifically, the Examiner asserted that “it has been within the skill in the art that the manner of operation or functional limitations would have insignificant patentable weight when an apparatus claim is being considered (see item 13 spanning pages 7 and 8 of the Final Office Action). Because it was not entirely clear whether the Examiner was not affording the limitation describing the arrangement of the gas flow passage proper patentable weight, or was instead taking the position that this arrangement was obvious in view of the prior art, an interview with the Examiner was requested.

During the Interview with the Examiner on July 22, 2003, the limitations concerning the arrangement of the gas flow passage with respect to the pair of electrodes was discussed at length. In addition, it was explained to the Examiner that the prior art references of record do not teach or even suggest this particular arrangement. As a follow-up to the Interview, a Request for Reconsideration was filed on July 23, 2003. In particular, the Applicants pointed out that the gas flow passage of the present invention is arranged so that gas flows through the gas flow space in a direction transverse to a longitudinal direction of the parallel grooves (or concentric grooves, in independent claim 19). Nonetheless, the Examiner issued an Advisory Action on September 3, 2003, in which the Examiner maintained the prior art rejections of claims 13, 14, and 16-22. Specifically, the Examiner asserted that apparatus claims must be structurally distinguishable from the prior art, and further asserted that “the manner of operating the device does not differentiate apparatus claims from the prior art.” Although the Applicants do not disagree with the Examiner that the manner of operating a claimed device is not necessarily a patentable feature, the Applicants disagree with the Examiner’s apparent position that the functional language recited in independent claim 13 to describe the gas flow passage is merely a “manner of operating the device” which is not sufficient to distinguish the present invention from the prior art.

It is well established that functional language recited in an apparatus claim to describe the structure of the claimed apparatus is entitled to as much patentable weight as any other positively-recited limitation in the claims. See *K-2 Corp. vs. Salomon S. A.*, 191 F.3d 1356, 1363, 52 USPQ2d 1001, 1006 (Fed. Circ. 1999) (“The functional language is, of course, an additional limitation in the claim.”); *Wright Med. Tech., Inc. v. Osteonics Corp.*, 122 F.3d 1440, 1443-44, 43 USPQ2d 1837,

1840 (Fed. Circ.1997) (functional language analyzed as a claim limitation). Therefore, the functional language recited in independent claim 13, such as the limitation “said gas flow passage being arranged so that the material gas flows through said gas flow space in a direction transverse to a longitudinal direction of said parallel grooves,” should be afforded full patentable weight by the Examiner insofar as it describes the structure of the ozone generator.

In this regard, it is submitted that the functional language recited in claim 13 describing the gas flow passage, in combination with the recitation that the gas flow passage includes an inlet port and an outlet port, clearly describes a portion of the *structure* of the ozone generator, rather than merely describing a particular manner of operating the ozone generator. Specifically, as explained above, the particular arrangement of a gas flow passage, including the location of the inlet port and the outlet port, will dictate the direction of flow of a gas through an apparatus. Conversely, the direction of flow of the gas through the apparatus is based on the structure of the apparatus. Furthermore, based on the above-cited case law, the Applicants are clearly entitled to use functional language describing the flow of the material gas through the passage in order to ultimately describe the structure of the gas flow passage. Therefore, it is submitted that the Examiner must give the functional language recited in claim 13 full patentable weight.

The Duarte reference discloses a gas ionization device including an inner electrode tube 5, a dielectric tube 3, and an outer electrode tube 4. As illustrated in Figure 2, the outer surface of the inner electrode tube 5 and the inner surface of the outer electrode tube 4 have a spiked pattern etched thereon. However, as explained in column 4, lines 6-19, the electrodes are etched with a *spiral* spiked pattern. Thus, the Duarte reference does not disclose or suggest at least one electrode having a plurality of *parallel* grooves formed on a surface thereof, as recited in claim 13. Moreover, column 4, lines 18-22 of the Duarte reference teaches that the spiral spikes direct the feed gas in such a manner so as to cover the entire electrode surface. In other words, the Duarte reference is designed so that the gas will travel within the groove of the *spiral* spikes so as to cover the electrode surface, in direct contrast to a design in which the gas must travel in a direction *transverse* to a longitudinal direction of *parallel* grooves (i.e., over the ridges of the grooves) as in the present invention.

Therefore, it is respectfully submitted that the Duarte reference does not anticipate or even suggest the invention recited in independent claim 13.

The Shinjo reference and the Kamiya reference disclose ozone generators in which grooves are formed in at least one of the electrodes of the ozone generator. However, these references do not disclose or even suggest a gas flow passage including an inlet port and an outlet port, in which the gas flow passage is arranged so that the material gas flows through the gas flow space between the electrodes in a direction *transverse* to a longitudinal direction of parallel grooves. In this regard, the Examiner has acknowledged that the Shinjo reference is silent with respect to an inlet port (see top of page 3 of the Final Office Action of April 23, 2003), and the Examiner does not even discuss the presence of an inlet port or an outlet port in the Kamiya reference.

Nonetheless, in the Final Office Action, and again during the interview of July 22, 2003, the Examiner has taken the position that an inlet port and an outlet port are inherent for supplying gas into the gas flow space, and that the functional language describing the gas flow passage has “insignificant patentable weight.” Moreover, as discussed above with respect to the Advisory Action of September 3, 2003, the Examiner asserts that “the manner of operating the device” is not a patentable feature. Thus, the Examiner has apparently improperly disregarded the limitation describing the gas flow passage as being arranged such that the material gas flows *in a direction transverse to a longitudinal direction of the parallel grooves* (i.e., has disregarded the limitation describing the arrangement of the gas flow passage using functional language). As explained above, however, it is well-established that an Applicant can use functional language to describe structural elements in an apparatus claim, and this functional language is entitled to full patentable weight. Because the Shinjo reference and the Kamiya reference do not teach an ozone generator having a gas flow passage as recited in claim 13, it is submitted that the Shinjo reference and the Kamiya reference do not anticipate or even suggest the ozone generator recited in claim 13.

The JP’627 reference discloses an ozone generating device including an electrode 2 having projections 4. However, as explained in paragraph 22 on page 12 of the English translation, “the source gas is set to flow in the direction *parallel* to the longitudinal direction of the projections of the first electrode 2” (emphasis added). In other words, this reference teaches that the gas flow

passage is arranged so that the gas flows in a direction parallel to, rather than transverse to, the grooves. Moreover, this reference actually *teaches away* from the arrangement of the gas flow passage as recited in claim 13 by explaining that if the direction of the air current is orthogonal (i.e., transverse) to the longitudinal direction of the projections 4, an undesirable pressure loss will result. Therefore, this reference explains that “the air current *needs to be set parallel to the longitudinal direction of the projecting parts 4.*” (see paragraph 18, page 10 of the English translation). Thus, the JP’627 reference also does not anticipate or even suggest, and in fact teaches away from, the arrangement recited in independent claim 13.

The Ishioka reference also does not disclose or suggest an ozone generator including a gas flow passage arranged as recited in claim 13. Therefore, one of ordinary skill in the art would not be motivated to modify or combine the Shinjo reference, the Kamiya reference, the Duarte reference, the JP’627 reference, and the Ishioka reference so as to obtain the invention recited in independent claim 13. Accordingly, it is respectfully submitted that independent claim 13 and claims 14 and 16-18 that depend therefrom are clearly patentable over the prior art of record.

Claims 19-22 are Patentable Over the Applied Prior Art.

Independent claim 19 is directed to an electric discharge cell for an ozone generator, as described above. In particular, the electric discharge cell comprises a pair of electrodes spaced apart in an opposing relationship so as to form a gas flow space therebetween. A first one of the electrodes has a plurality of *concentric circular grooves* formed on a disc-shaped surface thereof facing the gas flow space. A gas flow passage includes an inlet port for supplying a material gas into the gas flow space, and includes an outlet port for discharging the material gas from the gas flow space. The gas flow passage is arranged so that the material gas flows through the gas flow space *in a radial direction transverse to the concentric circular grooves.*

As with claim 13, the Examiner appears to be disregarding the functional language recited in claim 19 as merely being a “manner of operating the device.” However, as explained above with respect to independent claim 13, the functional language recited in claim 19 is used to describe the

structure of the electric discharge cell and, particularly, the arrangement of the gas flow passage. Thus, it is submitted that this limitation is entitled to full patentable weight by the Examiner.

The Duarte reference discloses an ozone generator including an inner electrode tube 5 and an outer electrode tube 4 each having a *spiral* spiked pattern etched thereon. Thus, the Duarte reference does not disclose or suggest at least one electrode having a plurality of *concentric* circular grooves formed on a surface thereof, as recited in claim 19. Moreover, the Duarte reference is designed so that the gas will travel within the groove of the *spiral* spikes so as to cover the electrode surface, in direct contrast to a design in which the gas must travel in a *radial direction transverse to the concentric circular grooves* (i.e., over the ridges of the grooves) as in the present invention. Therefore, it is respectfully submitted that the Duarte reference does not disclose or even suggest the electric discharge cell recited in independent claim 19.

As explained above with respect to claim 13, the Shinjo reference and the Kamiya reference disclose ozone generators in which grooves are formed in at least one of the electrodes of the ozone generator. However, the Shinjo reference and the Kamiya reference do not disclose or suggest an electric discharge cell in which one of the electrodes has a plurality of *concentric circular grooves* formed on a disc-shaped surface thereof, and in which a gas flow passage is arranged so that the material gas flows through the gas flow space in a *radial direction transverse to the concentric circular grooves*. Therefore, it is respectfully submitted that the Shinjo reference and the Kamiya reference do not disclose or even suggest the electric discharge cell recited in independent claim 19.

As also explained above with respect to claim 13, the JP'627 reference discloses an ozone generating device in which the source gas is set to flow in a direction *parallel* to the longitudinal direction of projections of a first electrode, but does not disclose a gas flow passage arranged so that the gas flows in a *radial direction transverse to concentric circular grooves*. Moreover, this reference actually *teaches away* from the arrangement of the gas flow passage as recited in claim 19 by explaining that if the direction of the air current is orthogonal (i.e., transverse) to the longitudinal direction of the projections 4, an undesirable pressure loss will result. Thus, the JP'627 reference also does not disclose or even suggest, and in fact teaches away from, the electric discharge cell recited in independent claim 19.

The Ishioka reference also does not disclose or suggest an electric discharge cell including a gas flow passage arranged as recited in claim 19. Therefore, one of ordinary skill in the art would not be motivated to modify or combine the Shinjo reference, the Kamiya reference, the Duarte reference, the JP'627 reference, and the Ishioka reference so as to obtain the invention recited in independent claim 19. Accordingly, it is respectfully submitted that independent claim 19 and claims 20-22 that depend therefrom are clearly patentable over the prior art of record.

9. CONCLUSION.

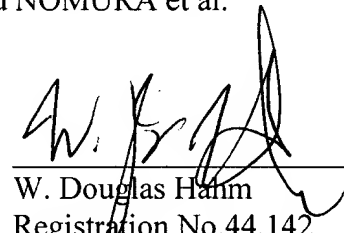
In view of the above, it is respectfully submitted that claims 13, 14, and 16-22 are not disclosed or suggested by the Shinjo reference, the Kamiya reference, the Duarte reference, the JP '627 reference, or the Ishioka reference, either alone or in combination. Accordingly, the Board is requested to reverse the rejections set forth in the Final Office Action of April 23, 2003.

This brief is submitted in triplicate with the requisite fee of \$330.00.

Respectfully submitted,

Osamu NOMURA et al.

By:



W. Douglas Hamm
Registration No. 44,142
Attorney for Appellants

WDH/gtg
Washington, D.C.
Telephone (202) 721-8203
Facsimile (202) 721-8250
November 24, 2003

APPENDIX I - Claims on Appeal, Application Serial No. 09/885,102

13. An ozone generator comprising:

a pair of electrodes spaced apart in an opposing relationship so as to form a gas flow space therebetween, at least one of said electrodes having a plurality of parallel grooves formed on a surface thereof facing said gas flow space;

electrically conductive members for connecting said electrodes to a power source to apply a voltage between said electrodes and thereby generate an electric discharge between said electrodes;

a dielectric arranged between said electrodes; and

a gas flow passage including an inlet port for supplying a material gas into said gas flow space, and including an outlet port for discharging the material gas from said gas flow space, said gas flow passage being arranged so that the material gas flows through said gas flow space in a direction transverse to a longitudinal direction of said parallel grooves.

14. The ozone generator of claim 13, wherein a first one of said electrodes has said parallel grooves formed on a surface thereof, a second one of said electrodes having a flat surface facing said gas flow space, said dielectric being arranged so as to cover said flat surface of said second one of said electrodes.

16. The ozone generator of claim 13, further comprising a holding plate supporting an insulating plate and supporting a first one of said electrodes on said insulating plate, said holding plate and a second one of said electrodes each having a cooling medium passage formed therein for allowing an electrically conductive cooling medium to flow through at least one of said cooling medium passage of said holding plate and said cooling medium passage of said second one of said electrodes.

17. The ozone generator of claim 13, further comprising a plurality of pairs of electrodes arranged in a stack, each of said pairs of electrodes being spaced apart in an opposing

relationship so as to form a gas flow space therebetween, at least one of each of said pairs of electrodes having a plurality of parallel grooves formed on a surface thereof facing said gas flow space.

18. The ozone generator of claim 13, wherein said dielectric comprises a sapphire.

19. An electric discharge cell for an ozone generator, comprising:

a pair of electrodes spaced apart in an opposing relationship so as to form a gas flow space therebetween, a first one of said electrodes having a plurality of concentric circular grooves formed on a disk-shaped surface thereof facing said gas flow space, and a second one of said electrodes having a flat dielectric plate arranged on and covering a disk-shaped surface thereof facing said gas flow space;

electrically conductive members for connecting said electrodes to a power source; and

a gas flow passage including an inlet port for supplying a material gas into said gas flow space, and including an outlet port for discharging the material gas from said gas flow space, said gas flow passage being arranged so that the material gas flows through said gas flow space in a radial direction transverse to said concentric circular grooves.

20. The electric discharge cell of claim 19, wherein said dielectric comprises a sapphire.

21. The electric discharge cell of claim 19, wherein said inlet port of said gas flow passage is located at an outer periphery of said electrodes so that the material gas flows through said gas flow space in a radially-inward direction from the outer periphery of said electrodes to a center of said electrodes.

22. The electric discharge cell of claim 19, further comprising a holding plate supporting an insulating plate and supporting a supported one of said first one of said electrodes and said second one of said electrodes on said insulating plate, said holding plate and a non-supported one of said first one of said electrodes and said second one of said electrodes each having a cooling

medium passage formed therein for allowing an electrically conductive cooling medium to flow through at least one of said cooling medium passage of said holding plate and said cooling medium passage of said non-supported one of said electrodes.



Fig. 1

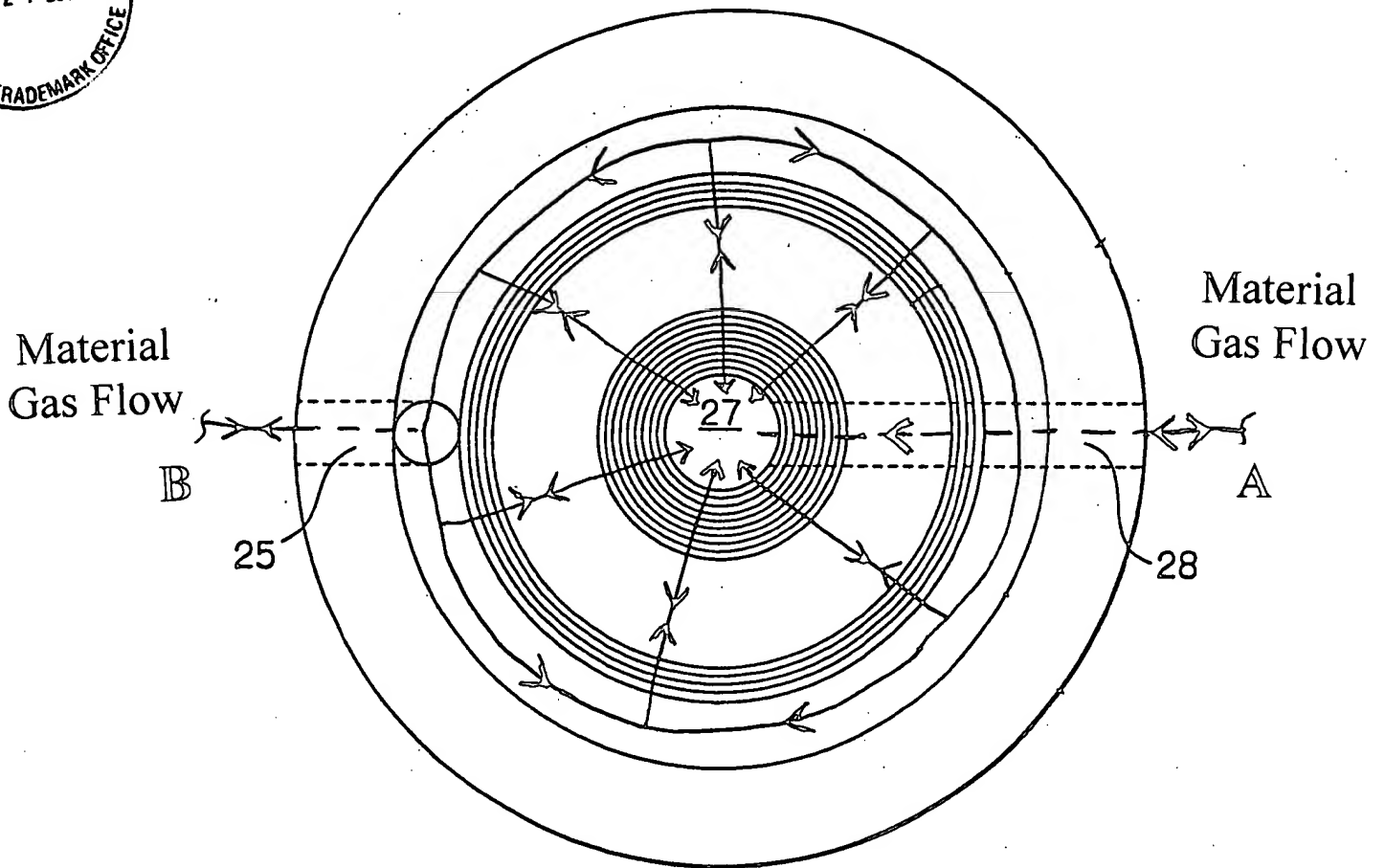
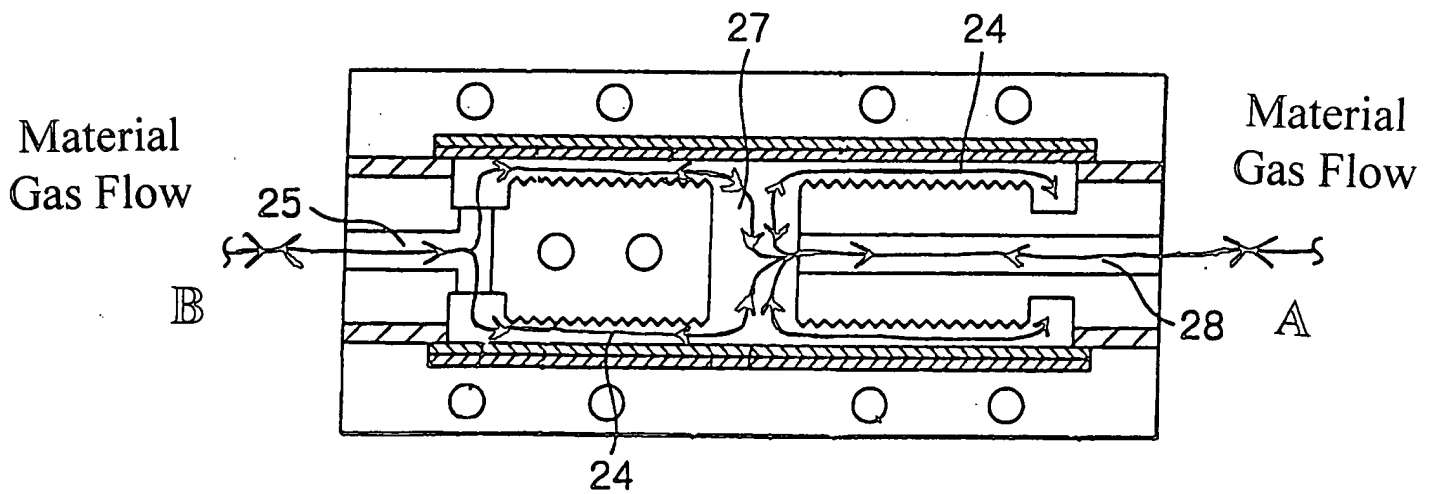
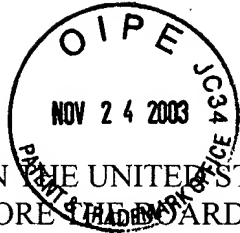


Fig. 2





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5. SUMMARY OF THE INVENTION.

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In order to highlight the structural differences between the present invention and the prior art, a brief description of conventional ozone generators will first be provided with reference to Figures 11 and 12 of the present application. Figure 11 is a cross-sectional view of a portion of a conventional ozone generation apparatus, including a high-voltage electrode 13 and an earth electrode 14. As explained in paragraph 4 spanning pages 1 and 2 of the substitute specification, the gas flow passage of the conventional ozone generator shown in Figure 11 is arranged so that the material gas flows in a direction *parallel* to the grooves 16. In other words, the inlet port and the outlet port for the material gas are located such that the material gas will flow in a direction that is perpendicular to the surface of the paper on which Figure 11 is printed. During operation, and particularly during low-flow operation, the material gas flowing in a direction parallel to the grooves

16 will tend to collect in the area "Q" illustrated in Figure 12, rather than in the desirable area "P," where a high density of discharge is developed so as to easily generate a gas containing a high concentration of ozone. Thus, it is difficult to obtain a high concentration of ozone in the conventional ozone generators, particularly during low flow conditions (see paragraph 6 on page 2 of the substitute specification).

In view of the above problems, the inventors have determined that an ozone generator must be designed so that the material gas is *forced* to flow over the ridge portions (indicated by reference number 12 of Figure 12) of the high voltage electrode, where a high density of discharge is achieved. One arrangement of the present invention that achieves this result is illustrated in Figure 5 and described in paragraph 66 on page 13 of the substitute specification (and this embodiment corresponds to the embodiment of the invention recited in independent claim 13). In particular, a pair of electrodes, including a low-voltage electrode 22 and a high-voltage electrode 42 are spaced apart in an opposing relationship. At least one of the electrodes (low-voltage electrode 22) has a plurality of parallel grooves 23 formed on a surface thereof facing the gas flow space 24. Electrically conductive members 21, 49 connect the electrodes to a power source 17 so as to apply a voltage between the electrodes and thereby generate an electric discharge between the electrodes. A dielectric 43 is arranged between the electrodes. A gas flow passage 24 includes an inlet port (the opening between the electrodes located at the right side of Figure 5) for supplying a material gas G into the gas flow space, and includes an outlet port (the opening between the electrodes located at the left side of Figure 5) for discharging the material gas G from the gas flow space. As clearly illustrated in Figure 5, the gas flow passage 24 is arranged so that the material gas G flows through the gas flow space in a direction transverse (as indicated by the arrow) to a longitudinal direction of the parallel grooves. Due to the arrangement of the gas flow passage and the fact that the grooves are parallel, the material gas G is forced to flow over the ridge portions of the grooves 23, where a high density of discharge will be located during operation. Consequently, the concentration of ozone generated is greatly improved.

It is to be understood that the present invention is designed based on the well-known principle that fluids (and, specifically, gases) always flow from an area of high pressure (such as an

inlet port) to an area of low pressure (such as an outlet port). The present inventors determined that by applying this principle to conventional ozone generators and changing the *structural arrangement* of the gas flow passage including the inlet port and the outlet port, the material gas can be forced to flow over the ridges of the grooves so as to improve the generation of ozone.

An alternate embodiment of the present invention (as recited in independent claim 19) is illustrated in Figures 1 and 2, and described on pages 10 and 11 of the substitute specification. In particular, a pair of electrodes (low-voltage electrode 22 and high-voltage electrode 42) are spaced apart in an opposing relationship so as to form a gas flow space therebetween. One of the electrodes (the low-voltage electrode 22) has a plurality of concentric circular grooves 23 formed on a disc-shaped surface facing the gas flow space, and the other electrode has a flat dielectric plate 43 arranged on and covering a disc-shaped surface facing the gas flow space. Electrically conductive members are provided for connecting the electrodes to a power source (see paragraph 58 on page 10 of the substitute specification). A gas flow passage 24, 25, 26, 27, 28 includes an inlet port 25 for supplying a material gas into the gas flow space, and includes an outlet port 27, 28 for discharging the material gas from the gas flow space. The gas flow passage is arranged so that the material gas flows through the gas flow space in a radial direction transverse to the concentric circular grooves.

In an attempt to aid in the understanding of the flow of the material gas through the electric discharge cell of the second embodiment shown in Figures 1 and 2, a marked-up copy of Figures 1 and 2 has been prepared and submitted herewith as Appendix II. Although Figure 2 indicates that the gas enters the ozone generator electric discharge cell 100 through the inlet port 25 (located at the left-hand side of Figures 1 and 2), it is also possible for the flow of the material gas to be reversed so that the gas enters the electric discharge cell through guide passage 28. Consequently, in the attached marked-up Figures 1 and 2, the gas can enter the electric discharge cell at either location "B" or location "A," and the flow path is indicated by lines with arrows pointing in both directions. Regardless of the flow direction, it is clear from these drawings that, due to the location of the inlet port and the outlet port, the material gas *must flow* in a radial direction transverse to the concentric circular grooves formed on the surface of the low-voltage electrode 22. In other words, if the material gas enters through inlet passage 25, it must then flow from annular passage 26 (see Figure

2 of the application) toward central space 27 in a radial direction transverse to the concentric circular grooves as illustrated in the marked-up Figures. The material gas then flows from the central space 27 through the outlet passage 28 to be discharged. Alternatively, the material gas can enter the electric discharge cell through the guide passage 28 communicating with the central space 27. The material gas then *must flow* in a radial direction transverse to the concentric circular grooves from the central space 27 to the annular space 26 through space 24, and is then discharged through the outlet passage 25. Due to the arrangement of the gas flow passage and the fact that the grooves are concentric, the material gas G is forced to flow over the ridges of the concentric grooves 23 where a high density of discharge is located. Consequently, ozone generation is greatly improved.

6. ISSUES.

A first issue is whether claims 13 and 14 are anticipated under 35 USC 102(b) by Shinjo et. al., U.S. Patent No. 5,538,695 (“the Shinjo reference”).

A second issue is whether claims 13, 14, and 18 are anticipated under 35 USC 102(b) by Kamiya et. al., U.S. Patent No. 5,549,874 (“the Kamiya reference”).

A third issue is whether claim 13 is anticipated under 35 USC 102(b) by Duarte, U.S. Patent No. 5,554,344 (“the Duarte reference”).

A fourth issue is whether claims 13 and 14 are anticipated under 35 USC 102(b) by Japanese Document No. JP-2540627 (“the JP ‘627 reference”).

A fifth issue is whether claims 17, 19, and 21 are obvious under 35 USC 103 in view of the teachings of the Shinjo reference.

A sixth issue is whether claims 17 and 19-21 are obvious under 35 USC 103 in view of the teachings of the Kamiya reference.

A seventh issue is whether claims 16 and 22 are obvious under 35 USC 103 in view of the teachings of the Shinjo reference and the JP '627 reference, and further in view of Ishioka et. al., U.S. Patent No. 6,027,700, ("the Ishioka reference").

The above issues are more specifically directed to the following question: Is the functional language recited in the rejected claims to describe the arrangement of the gas flow passage with respect to the parallel or concentric grooves sufficient to distinguish the claimed invention from the applied prior art?

7. GROUPING OF CLAIMS.

Claims 13 and 19 do not stand or fall together.

Claims 14 and 16-18 stand or fall with claim 13.

Claims 20-22 stand or fall with claim 19.

8. ARGUMENT.

Claims 13, 14, and 16-18 are Patentable Over the Applied Prior Art.

Independent claim 13, and claims 14-18 that depend from claim 13, are directed to an ozone generator as described above. In particular, the ozone generator comprises a pair of electrodes spaced apart in an opposing relationship, and at least one of the electrodes has a plurality of parallel grooves formed on a surface thereof facing the gas flow space. A gas flow passage includes an inlet port for supplying a material gas into the gas flow space, and includes an outlet port for discharging material gas from the gas flow space, and the gas flow passage is arranged so that the material gas flows through the gas flow space in a direction transverse to a longitudinal direction of the parallel grooves.

In the final Office Action of April 23, 2003, the Examiner responded to the Applicant's arguments that the prior art references do not teach ozone generators with a gas flow passage

arranged as recited in independent claim 13. Specifically, the Examiner asserted that “it has been within the skill in the art that the manner of operation or functional limitations would have insignificant patentable weight when an apparatus claim is being considered (see item 13 spanning pages 7 and 8 of the Final Office Action). Because it was not entirely clear whether the Examiner was not affording the limitation describing the arrangement of the gas flow passage proper patentable weight, or was instead taking the position that this arrangement was obvious in view of the prior art, an interview with the Examiner was requested.

During the Interview with the Examiner on July 22, 2003, the limitations concerning the arrangement of the gas flow passage with respect to the pair of electrodes was discussed at length. In addition, it was explained to the Examiner that the prior art references of record do not teach or even suggest this particular arrangement. As a follow-up to the Interview, a Request for Reconsideration was filed on July 23, 2003. In particular, the Applicants pointed out that the gas flow passage of the present invention is arranged so that gas flows through the gas flow space in a direction transverse to a longitudinal direction of the parallel grooves (or concentric grooves, in independent claim 19). Nonetheless, the Examiner issued an Advisory Action on September 3, 2003, in which the Examiner maintained the prior art rejections of claims 13, 14, and 16-22. Specifically, the Examiner asserted that apparatus claims must be structurally distinguishable from the prior art, and further asserted that “the manner of operating the device does not differentiate apparatus claims from the prior art.” Although the Applicants do not disagree with the Examiner that the manner of operating a claimed device is not necessarily a patentable feature, the Applicants disagree with the Examiner’s apparent position that the functional language recited in independent claim 13 to describe the gas flow passage is merely a “manner of operating the device” which is not sufficient to distinguish the present invention from the prior art.

It is well established that functional language recited in an apparatus claim to describe the structure of the claimed apparatus is entitled to as much patentable weight as any other positively-recited limitation in the claims. See *K-2 Corp. vs. Salomon S. A.*, 191 F.3d 1356, 1363, 52 USPQ2d 1001, 1006 (Fed. Circ. 1999) (“The functional language is, of course, an additional limitation in the claim.”); *Wright Med. Tech., Inc. v. Osteonics Corp.*, 122 F.3d 1440, 1443-44, 43 USPQ2d 1837,

1840 (Fed. Circ. 1997) (functional language analyzed as a claim limitation). Therefore, the functional language recited in independent claim 13, such as the limitation “said gas flow passage being arranged so that the material gas flows through said gas flow space in a direction transverse to a longitudinal direction of said parallel grooves,” should be afforded full patentable weight by the Examiner insofar as it describes the structure of the ozone generator.

In this regard, it is submitted that the functional language recited in claim 13 describing the gas flow passage, in combination with the recitation that the gas flow passage includes an inlet port and an outlet port, clearly describes a portion of the *structure* of the ozone generator, rather than merely describing a particular manner of operating the ozone generator. Specifically, as explained above, the particular arrangement of a gas flow passage, including the location of the inlet port and the outlet port, will dictate the direction of flow of a gas through an apparatus. Conversely, the direction of flow of the gas through the apparatus is based on the structure of the apparatus. Furthermore, based on the above-cited case law, the Applicants are clearly entitled to use functional language describing the flow of the material gas through the passage in order to ultimately describe the structure of the gas flow passage. Therefore, it is submitted that the Examiner must give the functional language recited in claim 13 full patentable weight.

The Duarte reference discloses a gas ionization device including an inner electrode tube 5, a dielectric tube 3, and an outer electrode tube 4. As illustrated in Figure 2, the outer surface of the inner electrode tube 5 and the inner surface of the outer electrode tube 4 have a spiked pattern etched thereon. However, as explained in column 4, lines 6-19, the electrodes are etched with a *spiral* spiked pattern. Thus, the Duarte reference does not disclose or suggest at least one electrode having a plurality of *parallel* grooves formed on a surface thereof, as recited in claim 13. Moreover, column 4, lines 18-22 of the Duarte reference teaches that the spiral spikes direct the feed gas in such a manner so as to cover the entire electrode surface. In other words, the Duarte reference is designed so that the gas will travel within the groove of the *spiral* spikes so as to cover the electrode surface, in direct contrast to a design in which the gas must travel in a direction *transverse* to a longitudinal direction of *parallel* grooves (i.e., over the ridges of the grooves) as in the present invention.

Therefore, it is respectfully submitted that the Duarte reference does not anticipate or even suggest the invention recited in independent claim 13.

The Shinjo reference and the Kamiya reference disclose ozone generators in which grooves are formed in at least one of the electrodes of the ozone generator. However, these references do not disclose or even suggest a gas flow passage including an inlet port and an outlet port, in which the gas flow passage is arranged so that the material gas flows through the gas flow space between the electrodes in a direction *transverse* to a longitudinal direction of parallel grooves. In this regard, the Examiner has acknowledged that the Shinjo reference is silent with respect to an inlet port (see top of page 3 of the Final Office Action of April 23, 2003), and the Examiner does not even discuss the presence of an inlet port or an outlet port in the Kamiya reference.

Nonetheless, in the Final Office Action, and again during the interview of July 22, 2003, the Examiner has taken the position that an inlet port and an outlet port are inherent for supplying gas into the gas flow space, and that the functional language describing the gas flow passage has “insignificant patentable weight.” Moreover, as discussed above with respect to the Advisory Action of September 3, 2003, the Examiner asserts that “the manner of operating the device” is not a patentable feature. Thus, the Examiner has apparently improperly disregarded the limitation describing the gas flow passage as being arranged such that the material gas flows *in a direction transverse to a longitudinal direction of the parallel grooves* (i.e., has disregarded the limitation describing the arrangement of the gas flow passage using functional language). As explained above, however, it is well-established that an Applicant can use functional language to describe structural elements in an apparatus claim, and this functional language is entitled to full patentable weight. Because the Shinjo reference and the Kamiya reference do not teach an ozone generator having a gas flow passage as recited in claim 13, it is submitted that the Shinjo reference and the Kamiya reference do not anticipate or even suggest the ozone generator recited in claim 13.

The JP’627 reference discloses an ozone generating device including an electrode 2 having projections 4. However, as explained in paragraph 22 on page 12 of the English translation, “the source gas is set to flow in the direction *parallel* to the longitudinal direction of the projections of the first electrode 2” (emphasis added). In other words, this reference teaches that the gas flow

passage is arranged so that the gas flows in a direction parallel to, rather than transverse to, the grooves. Moreover, this reference actually *teaches away* from the arrangement of the gas flow passage as recited in claim 13 by explaining that if the direction of the air current is orthogonal (i.e., transverse) to the longitudinal direction of the projections 4, an undesirable pressure loss will result. Therefore, this reference explains that “the air current *needs to be set parallel to the longitudinal direction of the projecting parts 4.*” (see paragraph 18, page 10 of the English translation). Thus, the JP’627 reference also does not anticipate or even suggest, and in fact teaches away from, the arrangement recited in independent claim 13.

The Ishioka reference also does not disclose or suggest an ozone generator including a gas flow passage arranged as recited in claim 13. Therefore, one of ordinary skill in the art would not be motivated to modify or combine the Shinjo reference, the Kamiya reference, the Duarte reference, the JP’627 reference, and the Ishioka reference so as to obtain the invention recited in independent claim 13. Accordingly, it is respectfully submitted that independent claim 13 and claims 14 and 16-18 that depend therefrom are clearly patentable over the prior art of record.

Claims 19-22 are Patentable Over the Applied Prior Art.

Independent claim 19 is directed to an electric discharge cell for an ozone generator, as described above. In particular, the electric discharge cell comprises a pair of electrodes spaced apart in an opposing relationship so as to form a gas flow space therebetween. A first one of the electrodes has a plurality of *concentric circular grooves* formed on a disc-shaped surface thereof facing the gas flow space. A gas flow passage includes an inlet port for supplying a material gas into the gas flow space, and includes an outlet port for discharging the material gas from the gas flow space. The gas flow passage is arranged so that the material gas flows through the gas flow space *in a radial direction transverse to the concentric circular grooves.*

As with claim 13, the Examiner appears to be disregarding the functional language recited in claim 19 as merely being a “manner of operating the device.” However, as explained above with respect to independent claim 13, the functional language recited in claim 19 is used to describe the

structure of the electric discharge cell and, particularly, the arrangement of the gas flow passage. Thus, it is submitted that this limitation is entitled to full patentable weight by the Examiner.

The Duarte reference discloses an ozone generator including an inner electrode tube 5 and an outer electrode tube 4 each having a *spiral* spiked pattern etched thereon. Thus, the Duarte reference does not disclose or suggest at least one electrode having a plurality of *concentric* circular grooves formed on a surface thereof, as recited in claim 19. Moreover, the Duarte reference is designed so that the gas will travel within the groove of the *spiral* spikes so as to cover the electrode surface, in direct contrast to a design in which the gas must travel in a *radial direction transverse to the concentric circular grooves* (i.e., over the ridges of the grooves) as in the present invention. Therefore, it is respectfully submitted that the Duarte reference does not disclose or even suggest the electric discharge cell recited in independent claim 19.

As explained above with respect to claim 13, the Shinjo reference and the Kamiya reference disclose ozone generators in which grooves are formed in at least one of the electrodes of the ozone generator. However, the Shinjo reference and the Kamiya reference do not disclose or suggest an electric discharge cell in which one of the electrodes has a plurality of *concentric circular grooves* formed on a disc-shaped surface thereof, and in which a gas flow passage is arranged so that the material gas flows through the gas flow space in a *radial direction transverse to the concentric circular grooves*. Therefore, it is respectfully submitted that the Shinjo reference and the Kamiya reference do not disclose or even suggest the electric discharge cell recited in independent claim 19.

As also explained above with respect to claim 13, the JP'627 reference discloses an ozone generating device in which the source gas is set to flow in a direction *parallel* to the longitudinal direction of projections of a first electrode, but does not disclose a gas flow passage arranged so that the gas flows in a *radial direction transverse to concentric circular grooves*. Moreover, this reference actually *teaches away* from the arrangement of the gas flow passage as recited in claim 19 by explaining that if the direction of the air current is orthogonal (i.e., transverse) to the longitudinal direction of the projections 4, an undesirable pressure loss will result. Thus, the JP'627 reference also does not disclose or even suggest, and in fact teaches away from, the electric discharge cell recited in independent claim 19.

The Ishioka reference also does not disclose or suggest an electric discharge cell including a gas flow passage arranged as recited in claim 19. Therefore, one of ordinary skill in the art would not be motivated to modify or combine the Shinjo reference, the Kamiya reference, the Duarte reference, the JP'627 reference, and the Ishioka reference so as to obtain the invention recited in independent claim 19. Accordingly, it is respectfully submitted that independent claim 19 and claims 20-22 that depend therefrom are clearly patentable over the prior art of record.

9. CONCLUSION.

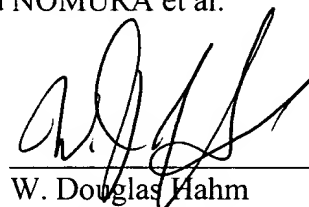
In view of the above, it is respectfully submitted that claims 13, 14, and 16-22 are not disclosed or suggested by the Shinjo reference, the Kamiya reference, the Duarte reference, the JP '627 reference, or the Ishioka reference, either alone or in combination. Accordingly, the Board is requested to reverse the rejections set forth in the Final Office Action of April 23, 2003.

This brief is submitted in triplicate with the requisite fee of \$330.00.

Respectfully submitted,

Osamu NOMURA et al.

By:



W. Douglas Hahm
Registration No.44,142
Attorney for Appellants

WDH/gtg
Washington, D.C.
Telephone (202) 721-8203
Facsimile (202) 721-8250
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APPENDIX I - Claims on Appeal, Application Serial No. 09/885,102

13. An ozone generator comprising:

a pair of electrodes spaced apart in an opposing relationship so as to form a gas flow space therebetween, at least one of said electrodes having a plurality of parallel grooves formed on a surface thereof facing said gas flow space;

electrically conductive members for connecting said electrodes to a power source to apply a voltage between said electrodes and thereby generate an electric discharge between said electrodes;

a dielectric arranged between said electrodes; and

a gas flow passage including an inlet port for supplying a material gas into said gas flow space, and including an outlet port for discharging the material gas from said gas flow space, said gas flow passage being arranged so that the material gas flows through said gas flow space in a direction transverse to a longitudinal direction of said parallel grooves.

14. The ozone generator of claim 13, wherein a first one of said electrodes has said parallel grooves formed on a surface thereof, a second one of said electrodes having a flat surface facing said gas flow space, said dielectric being arranged so as to cover said flat surface of said second one of said electrodes.

16. The ozone generator of claim 13, further comprising a holding plate supporting an insulating plate and supporting a first one of said electrodes on said insulating plate, said holding plate and a second one of said electrodes each having a cooling medium passage formed therein for allowing an electrically conductive cooling medium to flow through at least one of said cooling medium passage of said holding plate and said cooling medium passage of said second one of said electrodes.

17. The ozone generator of claim 13, further comprising a plurality of pairs of electrodes arranged in a stack, each of said pairs of electrodes being spaced apart in an opposing

relationship so as to form a gas flow space therebetween, at least one of each of said pairs of electrodes having a plurality of parallel grooves formed on a surface thereof facing said gas flow space.

18. The ozone generator of claim 13, wherein said dielectric comprises a sapphire.

19. An electric discharge cell for an ozone generator, comprising:

a pair of electrodes spaced apart in an opposing relationship so as to form a gas flow space therebetween, a first one of said electrodes having a plurality of concentric circular grooves formed on a disk-shaped surface thereof facing said gas flow space, and a second one of said electrodes having a flat dielectric plate arranged on and covering a disk-shaped surface thereof facing said gas flow space;

electrically conductive members for connecting said electrodes to a power source; and

a gas flow passage including an inlet port for supplying a material gas into said gas flow space, and including an outlet port for discharging the material gas from said gas flow space, said gas flow passage being arranged so that the material gas flows through said gas flow space in a radial direction transverse to said concentric circular grooves.

20. The electric discharge cell of claim 19, wherein said dielectric comprises a sapphire.

21. The electric discharge cell of claim 19, wherein said inlet port of said gas flow passage is located at an outer periphery of said electrodes so that the material gas flows through said gas flow space in a radially-inward direction from the outer periphery of said electrodes to a center of said electrodes.

22. The electric discharge cell of claim 19, further comprising a holding plate supporting an insulating plate and supporting a supported one of said first one of said electrodes and said second one of said electrodes on said insulating plate, said holding plate and a non-supported one of said first one of said electrodes and said second one of said electrodes each having a cooling

medium passage formed therein for allowing an electrically conductive cooling medium to flow through at least one of said cooling medium passage of said holding plate and said cooling medium passage of said non-supported one of said electrodes.

APPENDIX II

09/885,102

APPEAL BRIEF



Fig. 1

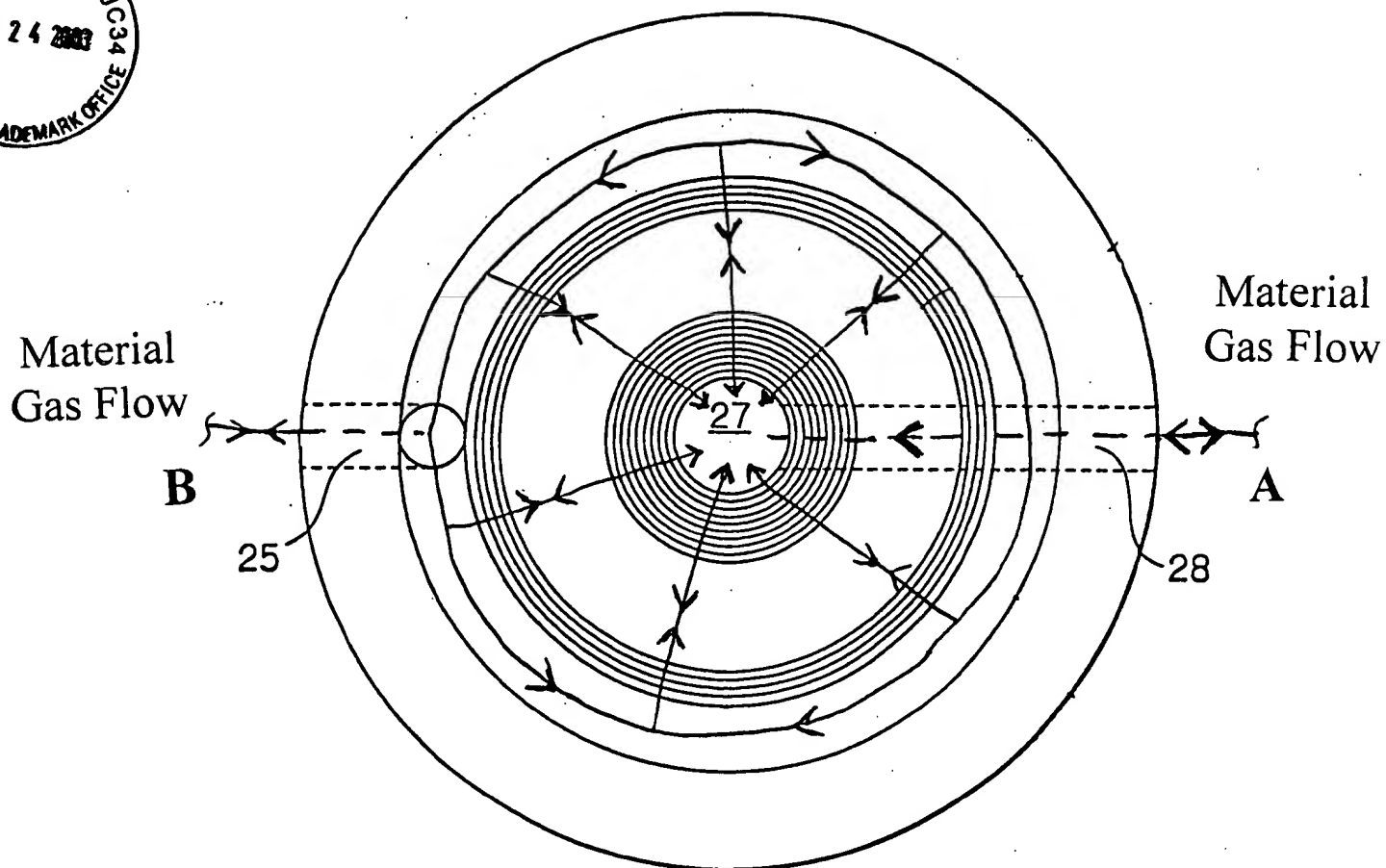


Fig. 2

